Surface-Water Studies In Currituck Sound

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science for a changing world

Outline

- Hydrology
- Tides and salinity
- Miscellaneous studies
- USGS studies
- NC DWQ ORW study

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Chesapeake Bay
Lynnhaven Bay
Norfolk
Lynnhaven River
Trants Point
Canal No. 2
WS1
London Bridge Creek
Portsmouth
City Limits
Virginia Beach
Shipps Corner Rd. crossing
Southern Branch Elizabeth River
Princess Anne
Albemarle and Chesapeake Canal
AC1
WN2
Pungo
Great Bridge Lock
West Neck Rd. crossing
West Neck Creek
Hell Point Creek
Muddy Creek
Beggars Bridge Creek
Nawney Creek
Atlantic
North Landing River
Pocaty River
Blackwater Creek
Chesapeake
Back Bay
Devil Creek
Oakum Creek
Milldam Creek
Walnut Creek
VIRGINIA
NORTH CAROLINA
Northwest River
Tull Bay
Tull Creek
Bell Island
CU1
Currituck Ferry Landing
Currituck
CAMDEN COUNTY
CURRITUCK COUNTY
Ocean
Church Island
Coinjock
CU2
Coinjock Canal
Pasquotank River
North River
Elizabeth City
WS2
CU3
Poplar Branch
PASQUOTANK COUNTY
Sound
Albemarle
Sound
CU4
Point Harbor
PERQUIMANS COUNTY
36°45'
36°30'
36°15'
Virginia
Study area
North Caro ina
Coastal Plain
LOCATION OF STUDY AREA AND COASTAL PLAIN PROVINCE IN VIRGINIA AND NORTH CAROLINA

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Some Hydrology

- **Drainage area = 733 mi^2**
  - **Currituck Sound = 153 mi^2**
  - **Back Bay = 40 mi^2**
  - **Approx. 30% of basin is open water**
  - **56% of basin is in NC→most land area in VA**
  - **3 main freshwater tributaries:**
    - **North Landing R.→largest at about 117 mi^2**
    - **Northwest R.**
    - **Tull C.**
  - **Other inflows:**
    - **AIWW**
    - **Westneck Creek – Canal Number 2**

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Some Hydrology

- Inflows are not well known
- In very round numbers
  - Hydraulic residence time ~ ¾ year (inflow/volume)
  - Rainfall on sound ~ 1. 5 times land runoff
  - Net rainfall (RF – evaporation) ~ 0.5 land runoff
  - Land runoff (normal):
    - 1/3 surface flow
    - 2/3 ground-water flow

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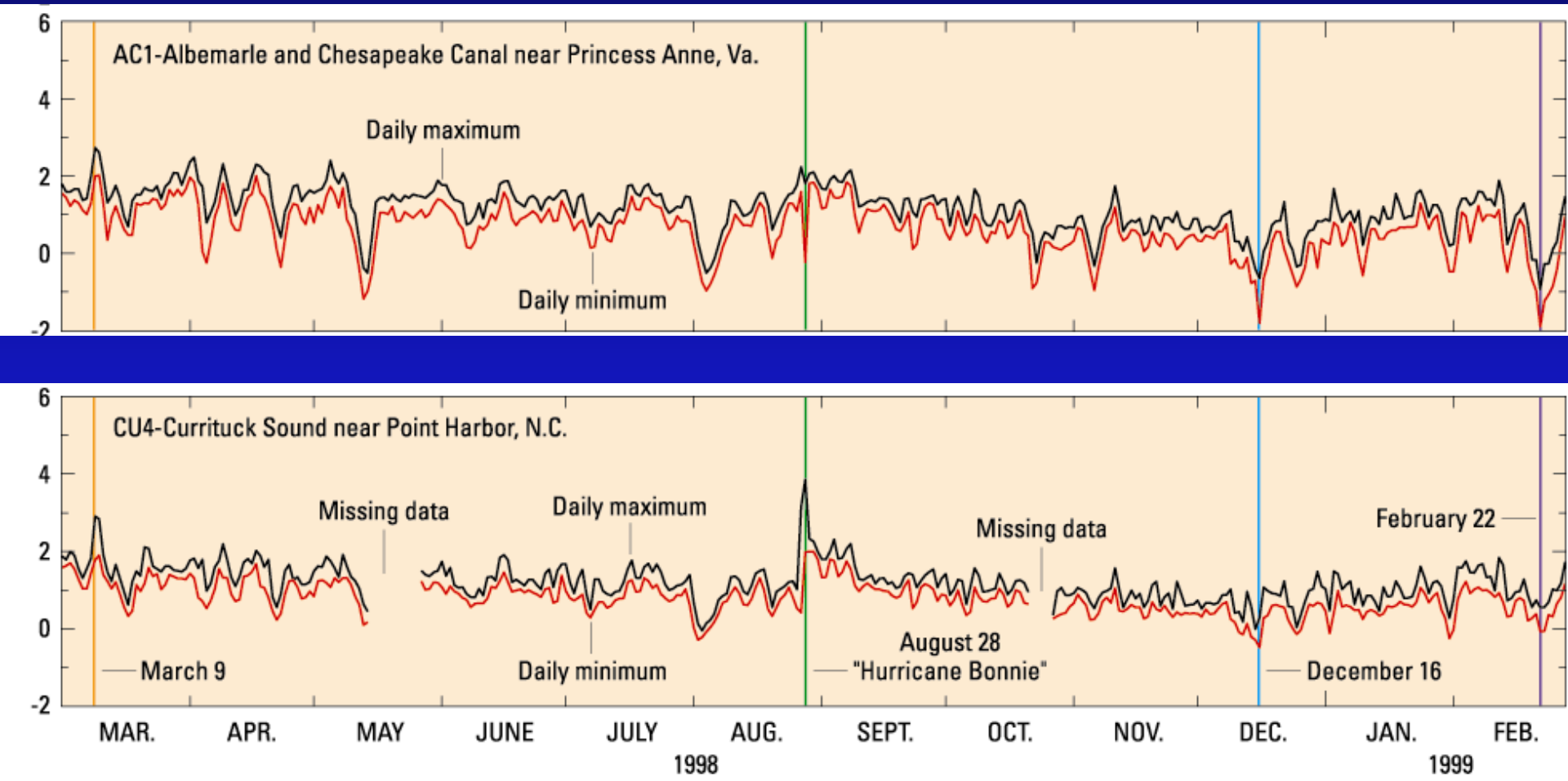
“Tides”


AC1-Albemarle and Chesapeake Canal near Princess Anne, Va.
Daily maximum
Daily minimum
6
4
2
0
-2
CU4-Currituck Sound near Point Harbor, N.C.
Missing data
Daily maximum
Missing data
February 22
March 9
Daily minimum
August 28
"Hurricane Bonnie"
December 16
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.
1998
1999

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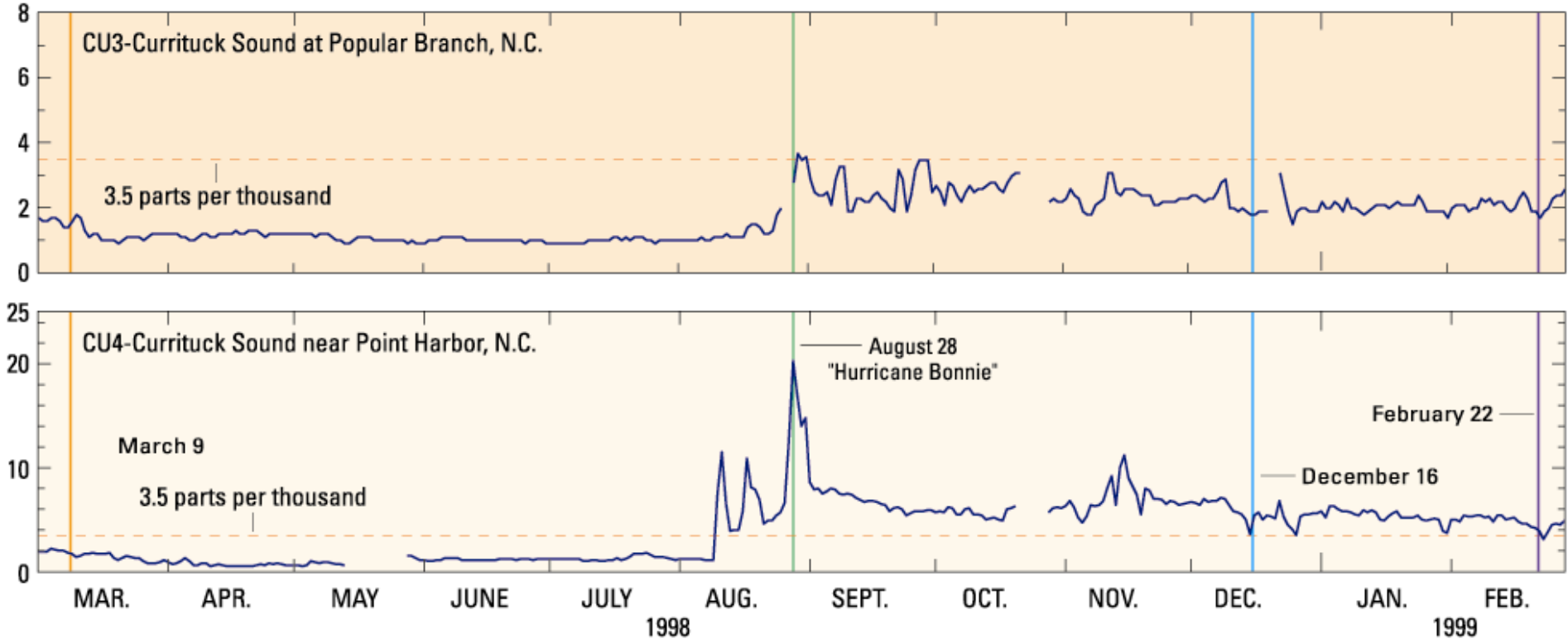
Salinity



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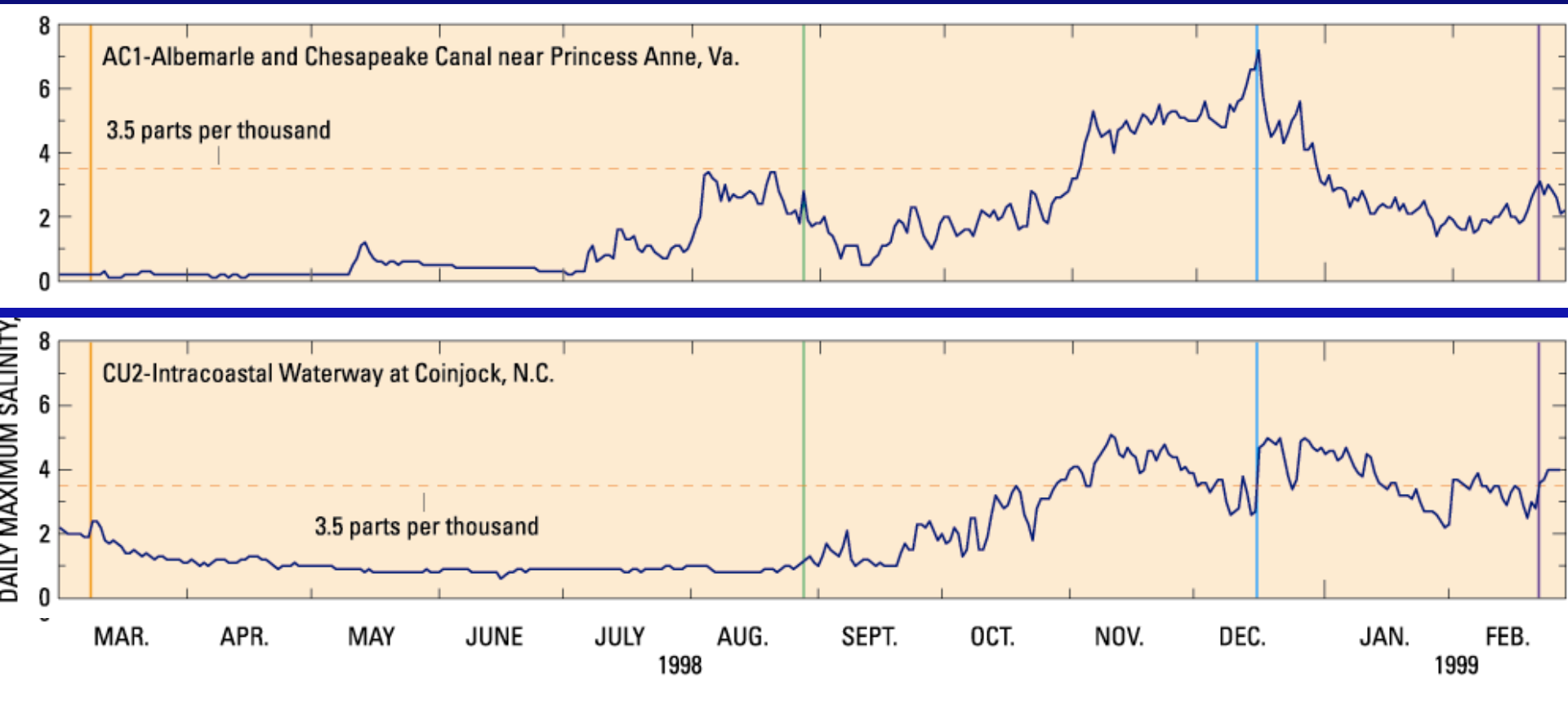
Salinity



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Miscellaneous Studies

- **NCSU (1993)**
  - **6.6 ft wind tide persisting for about 5 days would result in salt transport through Westneck Creek to Currituck Sound**
- **VA DEQ and Norfolk District COE**
  - **DEQ: Monthly salinity monitoring, 1983 – 89**
  - **COE: Monthly salinity monitoring, 1991 – 94**
  - **➔Canal No. 2 does not affect salinity in Currituck Sound**

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Miscellaneous Studies

- **NC WRC 1989 – 98**
  - **Monthly salinity at 4 sites (5 sites 94 – 98)**
  - **Salinity 0 – 9 ppt**
  - **Salinity > 3.5 ppt 5% of time**
- **NC DWR**
  - **Miscellaneous measurements in mid 1990's**
- **Other**
  - **mid 1950's data published by WRC**
  - **Late 1970's data by FWS**
  - **1982 – 89 data from DMF**

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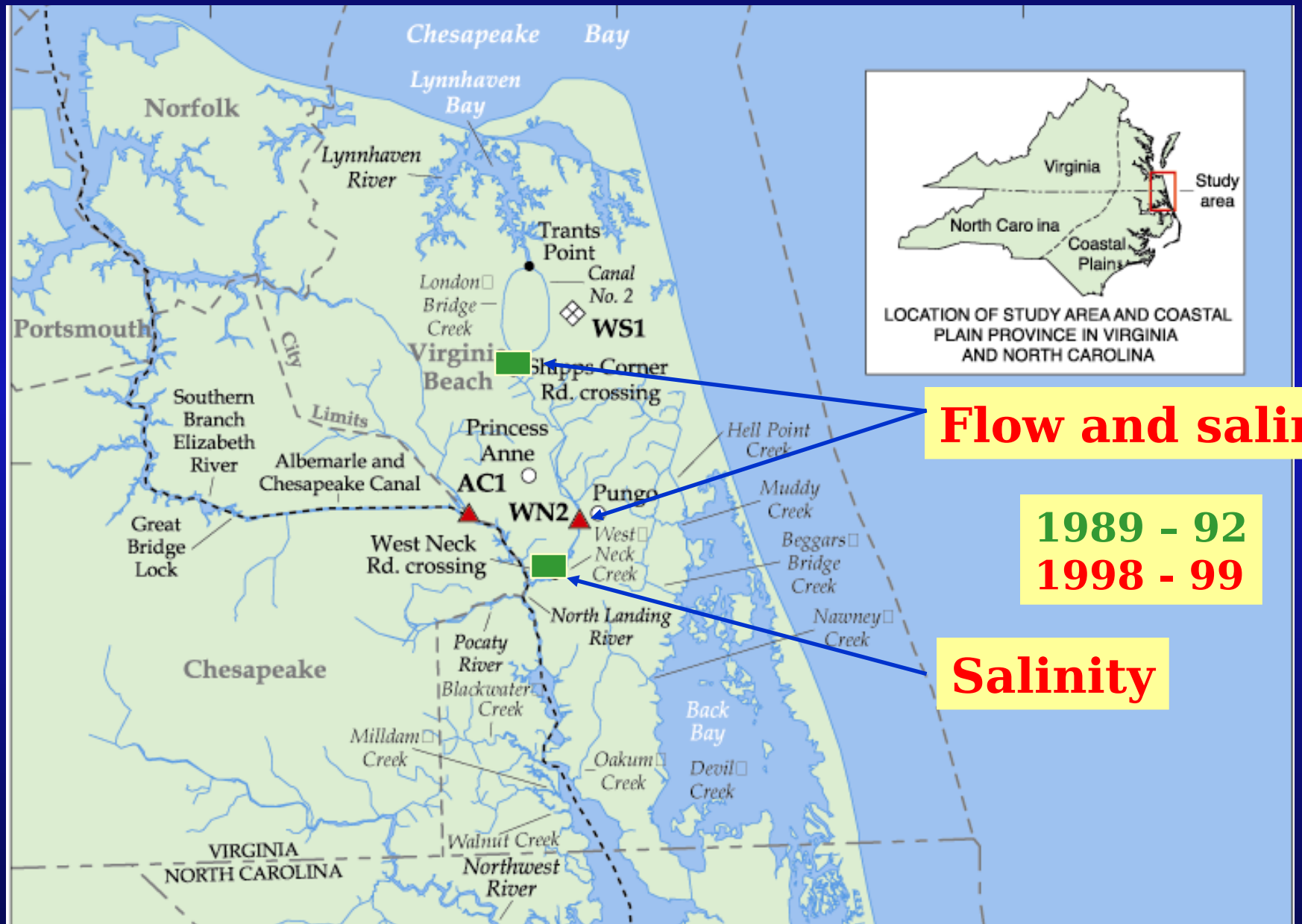
USGS Study: 1989 – 92



Summary of Results

- **Northern site**
  - **Water level range = - 1.2 – 4.45 ft**
  - **Flow range = 50 cfs N – 356 cfs S**
  - **Highest flows associated with rain events**
  - **Salinity range = 0.1 – 24.5 ppt**
    - **< 1 ppt about 55% of time**
    - **Highest salinities associated with winds from north**
    - **Salt transport for 294 days: 34,510 tons to south**
    - **Salt load evenly distributed through Currituck Sound would increase salinity of Sound < 0.02 ppt**

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Summary of Results

- **Southern site**
  - **Water level range = - 2.1 – 2.85 ft**
  - **Salinity range = 0.1 – 14.5 ppt (compared to 24.5 at northern site**
    - **< 1 ppt about 58% of time (about same as northern)**
    - **< 10 ppt about 99% of time**
    - **Little tidal fluctuation in salinity (unlike northern site)**

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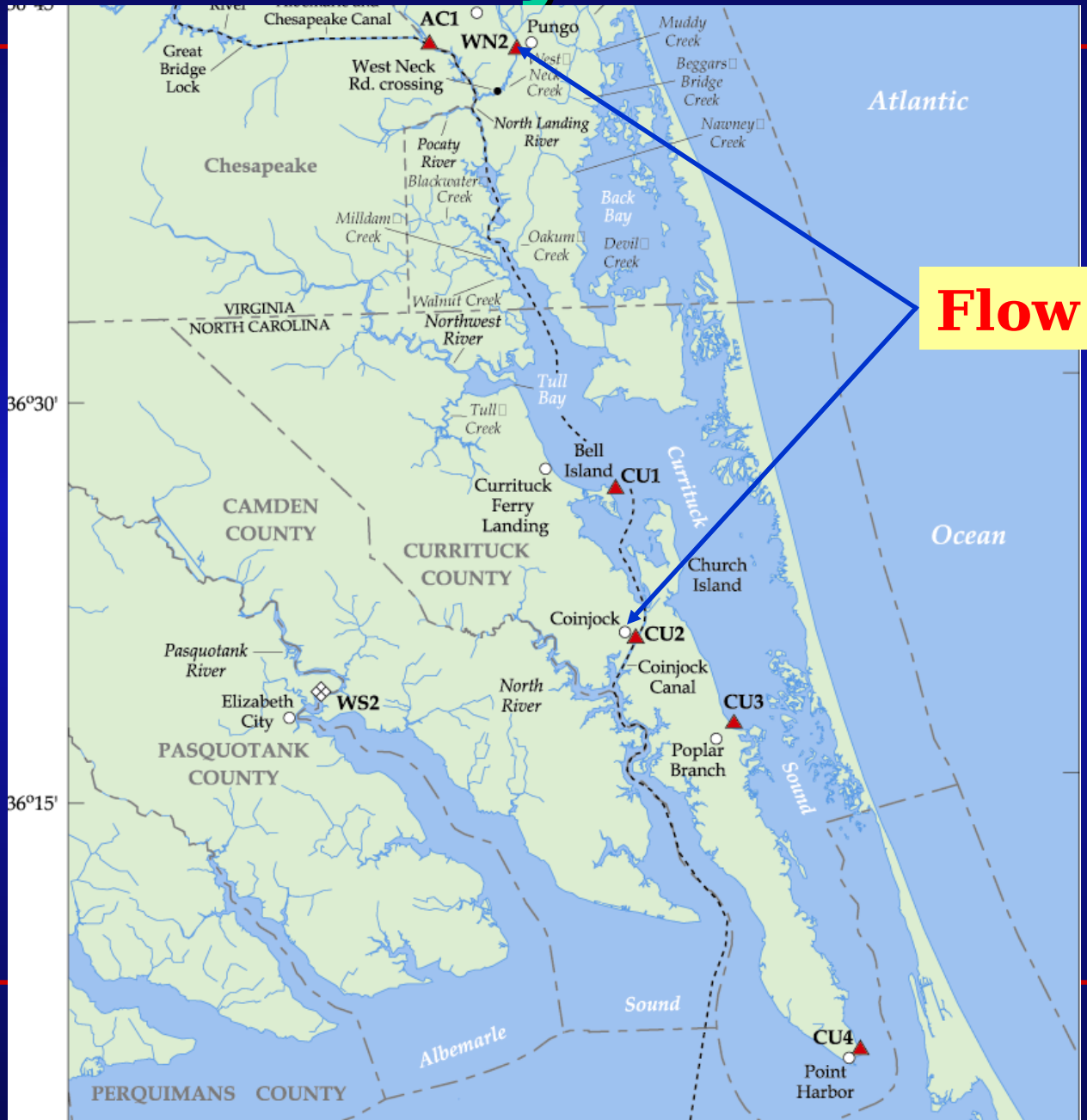
USGS Study 1998 – 99



Flow and salin

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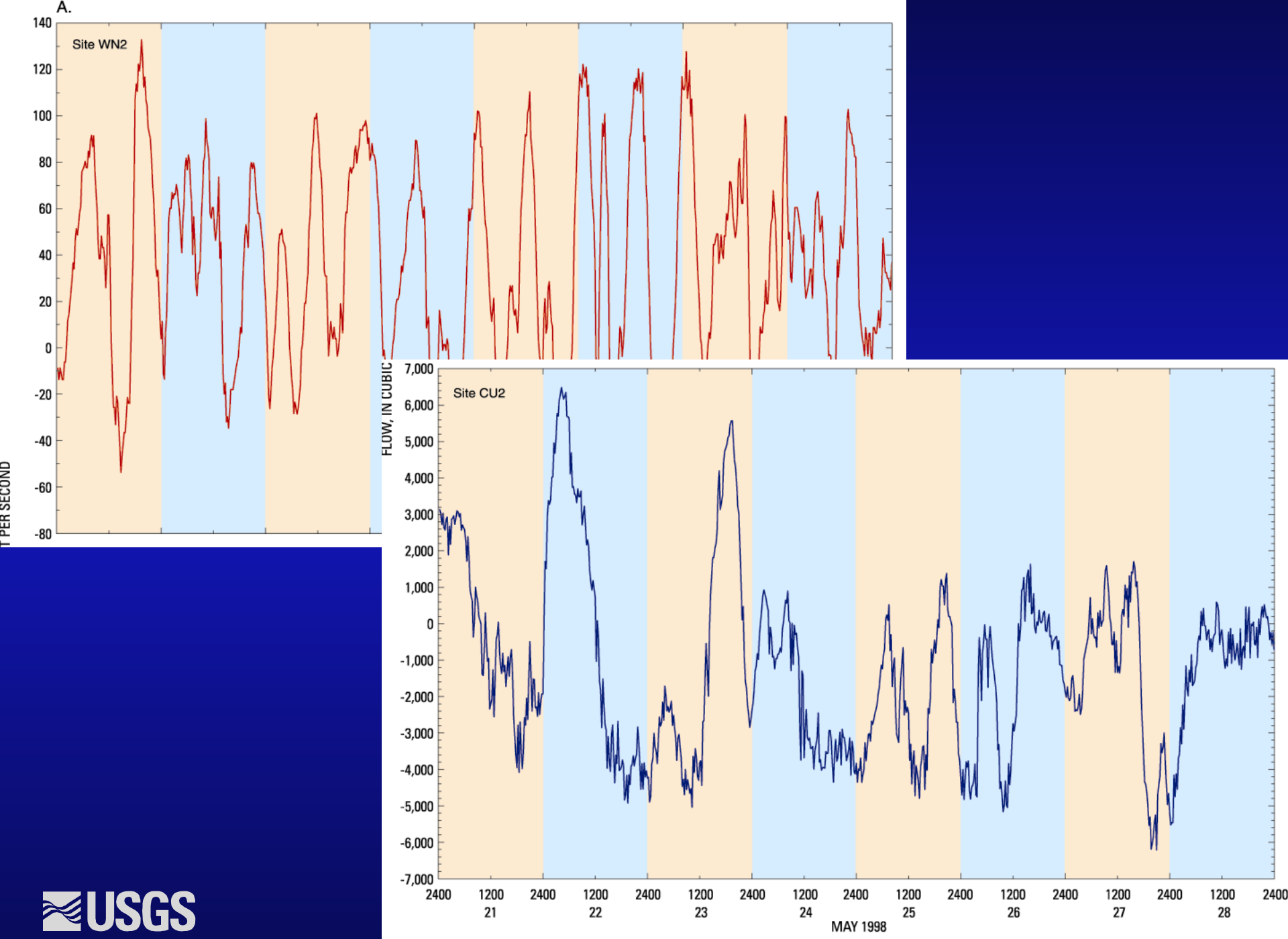
A.
Site WN2
140
120
100
80
60
40
20
0
-20
-40
-60
-80
T PER SECOND
Site CU2
FLOW, IN CUBIC
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
-7,000
2400
1200
21
22
23
24
25
26
27
28
MAY 1998

Figure 4

Flows

- **Westneck Creek**
  - **Flow to south 68 percent of time**
  - **Range: 313 cfs S – 227 cfs N**
- **Coinjock Canal**
  - **Flow to south 44 percent of time**
  - **Range: 15,300 cfs S – 11,700 cfs N**

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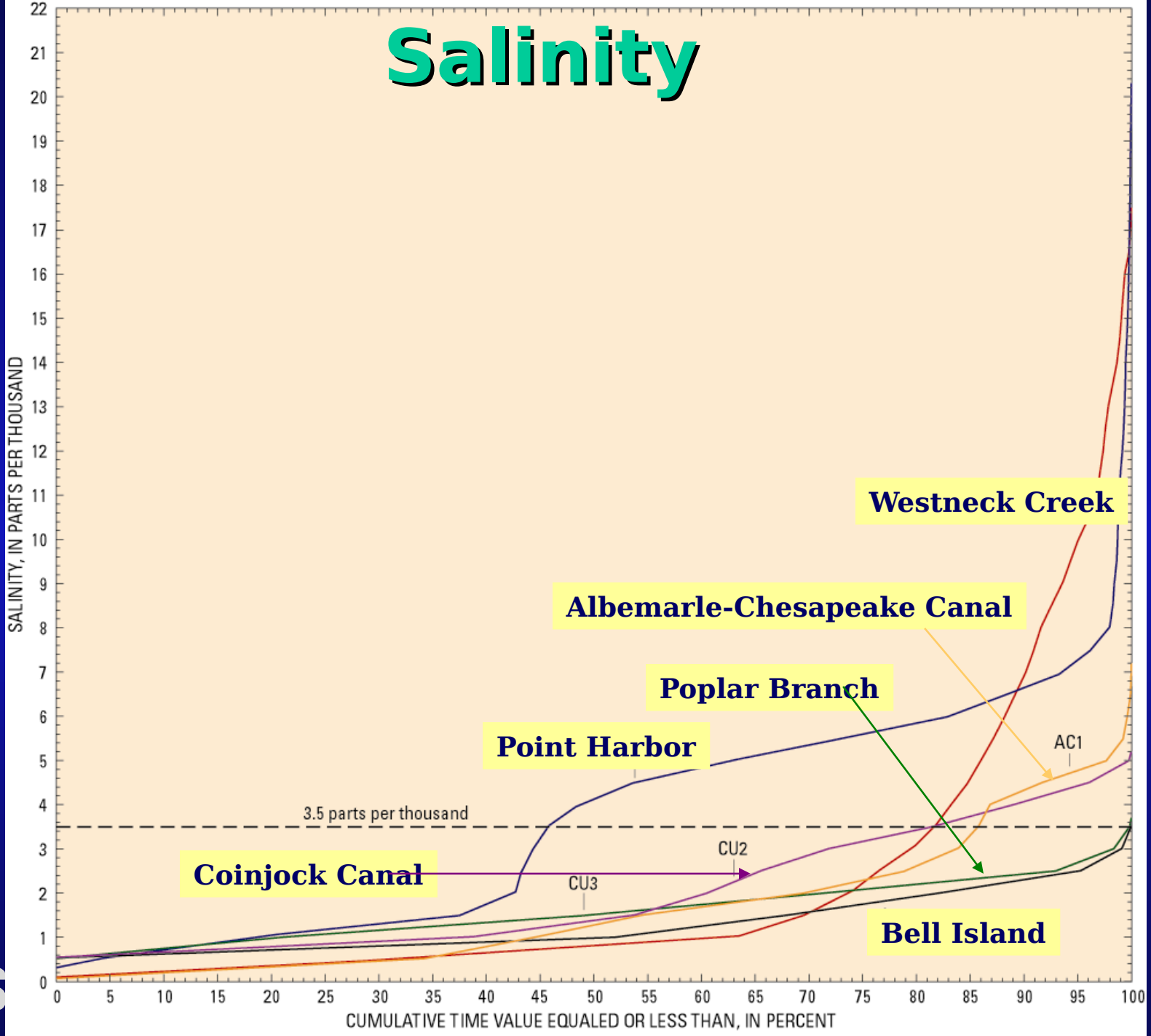
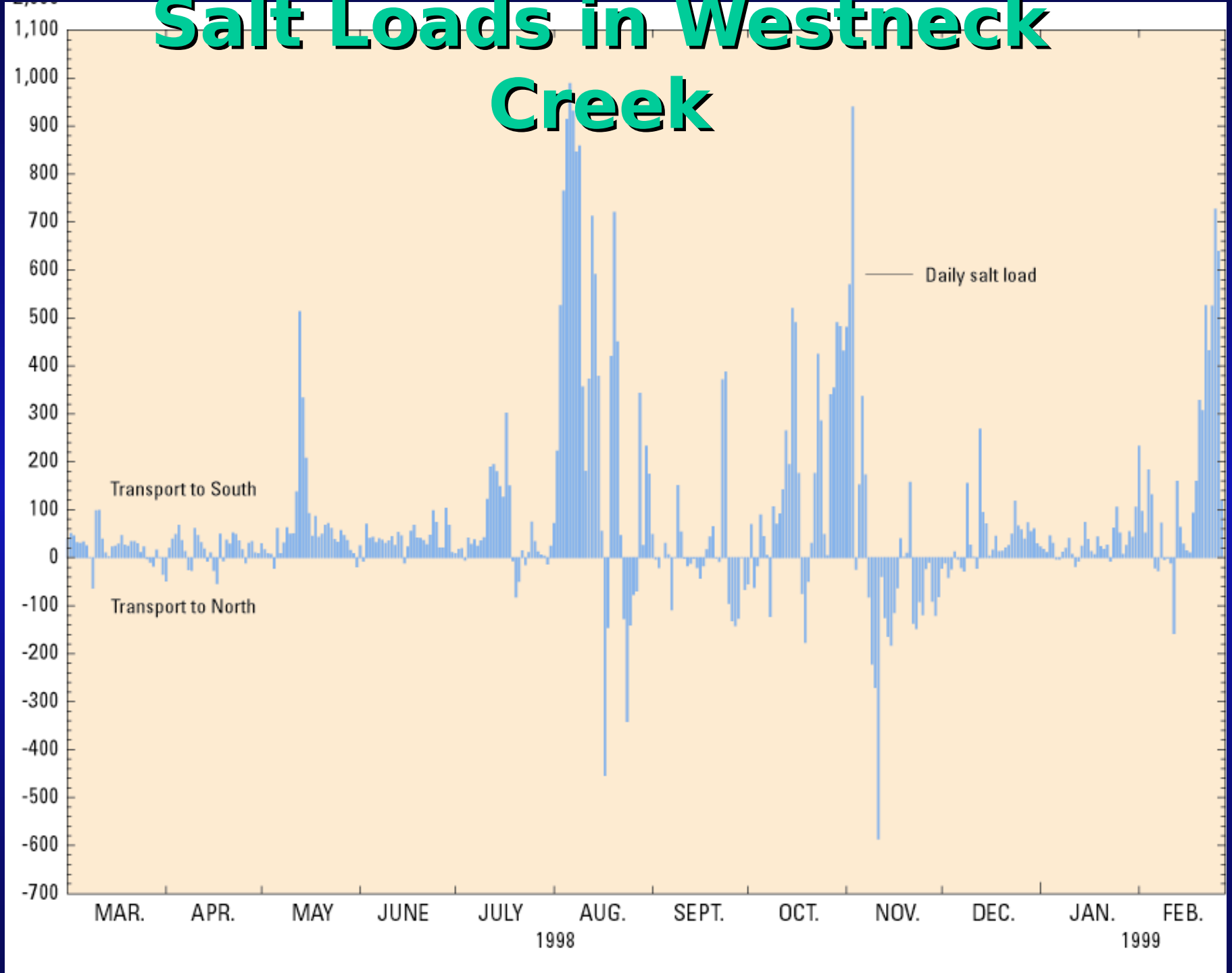
Salinity


SALINITY, IN PARTS PER THOUSAND
CUMULATIVE TIME VALUE EQUALED OR LESS THAN, IN PERCENT
3.5 parts per thousand
Westneck Creek
Albemarle-Chesapeake Canal
Poplar Branch
Point Harbor
Coinjock Canal
Bell Island
AC1
CU2
CU3

Salt Loads in Westneck Creek



Salt Loads

- **Westneck Creek**
  - **Net load for 1 year = 28,170 tons to south**
  - **Salt load evenly distributed through Currituck Sound would increase salinity of Sound < 0.01 ppt**
- **Coinjock Canal**
  - **872,700 tons to north**
  - **Salt load evenly distributed through Currituck Sound would increase salinity of Sound = 0.32 ppt**
- **Albemarle – Chesapeake Canal is likely a source of salt**

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NC DWQ 1994 ORW Study

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DWQ Results

- **Currituck Sound did not qualify as ORW because of high nutrients and chronic algal blooms.**
  - **Tull Creek largest source of N and P (note Northwest R. not sampled)**
  - **Back Bay is 2nd largest source of N**
  - **Jean Guite Creek also a source**
  - **Clarity increased to south**
  - **26 of 32 algal samples indicated “bloom” conditions—mostly blue-greens**
  - **EMAP sampling (1997): chlorophyll *a* > 47 ug/L**

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